California State University Channel Islands

Program Modification

Program Changes must be submitted by November 5, 2007

Date: Oct. 15, 2007 rev 12.5.07
Program Area: Biology
Semester/Year First effected: Fall 2008

Instructions: Please use the following format to modify any existing program.
Enter the latest approved version of your entire program in the left and right boxes below.
Make your deletions in the left hand column by using the strike-out feature of Word or underline what you wish to delete, and highlight.
Amendments to the program (on the right side) also need to be highlight in GREY so they can be identified for approval.
Please align your changes so that they appear side-by-side as much as possible for readability. Thank you.

CURRENTLY APPROVED PROGRAM

<table>
<thead>
<tr>
<th>PROGRAMS OFFERED</th>
<th>PROPOSED PROGRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Bachelor of Science in Biology</td>
<td>• Bachelor of Science in Biology</td>
</tr>
<tr>
<td>• Bachelor of Science in Biology with an Emphasis in Biotechnology</td>
<td>• Bachelor of Science in Biology with an Emphasis in Biotechnology</td>
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<tr>
<td>• Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology</td>
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<tr>
<td>• Bachelor of Science in Biology with an Emphasis in Ecology, Evolution and Organismal Biology</td>
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</tr>
<tr>
<td>• Bachelor of Science in Biology with an Emphasis in Medical Imaging</td>
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<tr>
<td>• Bachelor of Arts in Biology with an Emphasis in Ecology, Evolution and Organismal Biology</td>
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<tr>
<td>• Bachelor of Arts in Biology with an Emphasis in General Biology</td>
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<tr>
<td>• Bachelor of Arts in Biology with an Emphasis in Pre-Professional Studies</td>
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</tr>
<tr>
<td>• Bachelor of Arts in Biology with an Emphasis in Subject Matter Preparation in Teaching Biology</td>
<td>• Bachelor of Arts in Biology with an Emphasis in Subject Matter Preparation in Teaching Biology</td>
</tr>
<tr>
<td>• Master of Science in Biotechnology and Bioinformatics</td>
<td>• Master of Science in Biotechnology and Bioinformatics</td>
</tr>
<tr>
<td>• Master of Science in Biotechnology and Master of Business Administration</td>
<td>• Master of Science in Biotechnology and Master of Business Administration</td>
</tr>
<tr>
<td>• Minor in Biology</td>
<td>• Minor in Biology</td>
</tr>
<tr>
<td>• Certificate in Biotechnology</td>
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</tr>
<tr>
<td>• Honors in Biology</td>
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PROGRAM DESCRIPTION
Biology is the study of life, its origins, diversity and intricacies. It emphasizes the relationship between structure and function in living systems and the processes, by
which organisms grow, reproduce and interact with each other and their environment. The discipline is dynamic and rapidly advancing, particularly in the areas of biotechnology and information technology. The Biology Program provides its undergraduate and graduate students with a strong theoretical foundation in biology, combined with extensive hands-on laboratory experiences using state-of-the-art technology. Students take a series of core courses augmented by electives selected from areas of special interest.

### CAREERS

The Bachelor of Science in Biology is designed for students who wish to enter medical, dental or other health professional or graduate schools, or to seek careers in business, industry or government.

The Bachelor of Science in Biology with an Emphasis in Biotechnology enables students to make a smooth transition from academia to biotechnology industry by understanding the concepts of basic and applied biotechnology. This program allows students to have numerous career avenues and the groundwork for graduate study.

The Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology offers students an opportunity to study the exciting developments in genetics, molecular biology, cloning, biotechnology and bioinformatics. This program leads to careers in medical sciences, biotechnology, pharmaceuticals, research and development, intellectual property and patent law.

The Bachelor of Science in Biology with an Emphasis in Ecology, Evolution and Organismal Biology allows students to explore biodiversity at multiple levels of organization, from molecules to the biosphere. Students will gain an understanding of the complex interactions among organisms and between organisms and their physical environments. The emphasis prepares students for environmental studies, conservation, research, or education. It also provides preparation for graduate study in biology.

The Bachelor of Science in Biology with an Emphasis in Medical Imaging prepares students for graduate or professional study in the medical sciences (medical imaging, medical physics, health physics, dosimetry, nuclear medicine, radiotherapy, oncology, biomedical engineering), or for entry into professional positions in the clinical environment and in medical imaging research and development.

The Bachelor of Science in Biology with an Emphasis in Clinical Laboratory Science prepares students for further clinical training and California License Exam in Clinical Laboratory Science or for training and certification in Public Health Microbiology. This program allows students to have numerous career avenues and the groundwork for graduate study.

The Bachelor of Science in Biology with an Emphasis in Ecology, Evolution and Organismal Biology allows students to explore biodiversity at multiple levels of organization, from molecules to the biosphere. Students will gain an understanding of the complex interactions among organisms and between organisms and their physical environments. The emphasis prepares students for environmental studies, conservation, research, or education. It also provides preparation for graduate study in biology.
The Bachelor of Arts degree is designed to obtain a general background in both the concepts and the technical skills of modern biology. Students completing the Bachelor of Arts major will find that their strong general background will allow them flexibility in both completing minor fields of study and career choices. The degree prepares graduates for careers in medical and other health professions (Emphasis in Pre-Professional Studies), science education (Emphasis in Subject Matter Preparation in Teaching Biology), industry or government (Emphasis in General Biology).

Biology as a discipline has been rapidly advancing in the last decade. With the information derived from the sequencing of the genomes of many organisms, it will have far-reaching impacts on the environment, public health, and on local, regional, and global economies. The Biology Minor allows students in majors other than biology to gain an understanding of these exciting developments. It will provide a solid background in biology and the opportunity to explore selected area(s) at a greater depth. Equipped with a minor in biology, students with a major in other disciplines will have a greater understanding and knowledge of the latest advances in many areas of biology and will therefore be more versatile in their career paths. The requirement for a Minor in Biology is 21 units.

The Certificate in Biotechnology will provide students with advanced knowledge and skills in modern biotechnology that will lead to careers in biotechnology as well as pharmaceutical industries.

PROGRAM LEARNING OUTCOMES
Students graduating from the Biology program will be able to:
• explain the basic structures and fundamental processes of life at molecular, cellular and organismal levels;
• identify the evolutionary processes that lead to adaptation and biological diversity;
• describe the relationship between life forms and their environment and ecosystems;
• collect, organize, analyze, interpret and present quantitative and qualitative data and incorporate them into the broader context of biological knowledge;
• effectively apply current technology and scientific methodologies for problem solving;
• find, select and evaluate various types of scientific information including primary research articles, mass media sources and world-wide web information; and

The Bachelor of Science in Biology with an Emphasis in Medical Imaging prepares students for graduate or professional study in the medical sciences (medical imaging, medical physics, health physics, dosimetry, nuclear medicine, radiotherapy, oncology, biomedical engineering), or for entry into professional positions in the clinical environment and in medical imaging research and development.

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• describe the relationship between life forms and their environment and ecosystems;

5/25/2004 cp
• communicate effectively in written and oral forms.

REQUIREMENTS FOR HONORS IN BIOLOGY
Candidacy for honors in biology is voluntary. To be eligible, a student must fulfill the following requirements:
1. Achieve a minimum grade point average of 3.5 for all courses satisfying the requirements for the major as defined above;
2. Take at least seven courses in the major at this university;
3. Satisfactorily complete a Service Learning course from BIOL 492, 494 or 497;
4. Satisfactorily complete a Senior Capstone course.

Application for candidacy must be made at the beginning of the senior year. Approval of candidacy and of the Service Learning project and project advisor rests with the Biology Program. The project advisor will have the sole responsibility for acceptance of the completed project.

The Biology Program may grant honors to exceptional students who have not met the above requirements, but who have in the judgment of the Program brought distinction upon themselves and the Program in some other significant and appropriate manner.

FACULTY
Ching-Hua Wang, MD, PhD, Professor and Chair, Biology Program
Director of MS in Biotechnology and Bioinformatics
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Amy Denton, PhD, Assistant Professor of Biology
Phone: (805) 437-8458
Email: amy.denton@csuci.edu

Geoff Dougherty, PhD, Professor of Physics
Phone: (805) 437-8990
Email: geoffrey.dougherty@csuci.edu

Nancy Mozingo, PhD, Associate Professor of Biology

• collect, organize, analyze, interpret and present quantitative and qualitative data and incorporate them into the broader context of biological knowledge;
• effectively apply current technology and scientific methodologies for problem solving;
• find, select and evaluate various types of scientific information including primary research articles, mass media sources and world-wide web information; and
• communicate effectively in written and oral forms.

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Phone: (805) 437-8990
Email: geoffrey.dougherty@csuci.edu

Nancy Mozingo, PhD, Associate Professor of Biology
## REQUIREMENTS FOR THE BACHELOR OF SCIENCE DEGREE IN BIOLOGY (120 UNITS)

### Common Lower Division Requirements for All Emphases of the Bachelor of Science Degree in Biology (8 Units)

- **BIOL 200** Principles of Organismal and Population Biology, GE-B2 (4)
- **BIOL 201** Principles of Cell & Molecular Biology (4)

### FOR BACHELOR OF SCIENCE IN BIOLOGY

### Upper Division Requirements in the Major (39 Units)

1. **Required Biology Courses (25 units)**
   - **BIOL 300** Cell Biology (4)
   - **BIOL 302** Genetics (4)

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2. Electives in Biology (14 units)

Select from the following list of courses, one of which must be a lab course.

- BIOL 301 Microbiology (4)
- BIOL 310 Vertebrate Biology (4)
- BIOL 311 Plant Biology and Ecology (4)
- BIOL 312 Marine Biology (4)
- BIOL 313 Conservation Biology (4)
- BIOL 316 Invertebrate Zoology (4)
- BIOL 317 Parasitology (4)
- BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
- BIOL 402 Toxicology (3)
- BIOL 403 Foundations of Structural Biology (4)
- BIOL 404 Plant and Animal Tissue Culture (3)
- BIOL 405 Biochemical Engineering (4)
- BIOL 406 Evolutionary Biogeography (3)
- BIOL 407 Behavioral Ecology (3)
- BIOL 408 Nanobiotechnology (3)
- BIOL 420 Cellular & Molecular Immunology (4)
- BIOL 421 Virology (3)
- BIOL 422 Molecular Plant Physiology (4)
- BIOL 423 Cellular & Molecular Neurobiology (3)
- BIOL 424 Human Physiology (3)
- BIOL 425 Human Genetics (3)
- BIOL 427 Developmental Biology (4)
- BIOL 428 Biology of Cancer (3)
- BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)
- BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)
- BIOL 450 Ichthyology: The Biology of Fishes (4)
- BIOL 451 Ornithology (4)

2. Electives in Biology (14 units)

Select from the following list of courses, one of which must be a lab course.

- BIOL 301 Microbiology (4)
- BIOL 310 Vertebrate Biology (4)
- BIOL 311 Plant Biology and Ecology (4)
- BIOL 312 Marine Biology (4)
- BIOL 313 Conservation Biology (4)
- BIOL 316 Invertebrate Zoology (4)
- BIOL 317 Parasitology (4)
- BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
- BIOL 402 Toxicology (3)
- BIOL 403 Foundations of Structural Biology (4)
- BIOL 404 Plant and Animal Tissue Culture (3)
- BIOL 405 Biochemical Engineering (4)
- BIOL 406 Evolutionary Biogeography (3)
- BIOL 407 Behavioral Ecology (3)
- BIOL 408 Nanobiotechnology (3)
- BIOL 420 Cellular & Molecular Immunology (4)
- BIOL 421 Virology (3)
- BIOL 422 Molecular Plant Physiology (4)
- BIOL 423 Cellular & Molecular Neurobiology (3)
- BIOL 424 Human Physiology (3)
- BIOL 425 Human Genetics (3)
- BIOL 427 Developmental Biology (4)
- BIOL 428 Biology of Cancer (3)
- BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)
- BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)
- BIOL 450 Ichthyology: The Biology of Fishes (4)
- BIOL 451 Ornithology (4)

Required Supporting and Other GE Courses (73 Units)

1. Chemistry (16 units)

- CHEM 121* General Chemistry I, GE-B1 (4)
- CHEM 122 General Chemistry II, GE-B1 (4)
- CHEM 311 Organic Chemistry I (3)
- CHEM 312 Organic Chemistry I Laboratory (1)
- CHEM 314 Organic Chemistry II (3)
- CHEM 315 Organic Chemistry I Laboratory (1)

(A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315)

2. Physics (8 units)

Select either

- PHYS 100 Introduction to Physics I, GE-B1 (4)
- PHYS 101 Introduction to Physics II, GE-B1 (4)
- PHYS 200 General Physics I, GE-B1 (4)

5/25/2004 cp
No more than 2 units taken from the following:

<table>
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<tr>
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<tbody>
<tr>
<td>BIOL 492</td>
<td>Internship (2-3)</td>
</tr>
<tr>
<td>BIOL 494</td>
<td>Independent Research (1-3)</td>
</tr>
<tr>
<td>BIOL 497</td>
<td>Directed Study (1-3)</td>
</tr>
</tbody>
</table>

Required Supporting and Other GE Courses (73 Units)

1. Chemistry (16 units)
   - CHEM 121* General Chemistry I, GE-B1 (4)
   - CHEM 122 General Chemistry II, GE-B1 (4)
   - CHEM 311 Organic Chemistry I (3)
   - CHEM 312 Organic Chemistry I Laboratory (1)
   - CHEM 314 Organic Chemistry II (3)
   - CHEM 315 Organic Chemistry II Laboratory (1)
   
   *(A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315)*

2. Physics (8 units)
   - PHYS 100 Introduction to Physics I, GE-B1 (4)
   - PHYS 101 Introduction to Physics II, GE-B1 (4)
   - PHYS 200 General Physics I, GE-B1 (4)
   - PHYS 201 General Physics II, GE-B1 (4)

3. Statistics and Mathematics (7 units)
   - BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)
   - MATH 150* Calculus I, GE-B3 (4)

4. Other Required GE Courses in Categories A-E (36 units)
   - Category A (9 units)
   - Category C (12 units)
   - Category D (12 units)
   - Category E (3 units)

5. American Institutions Requirement (6 units)
5. American Institutions Requirement (6 units)

FOR EMPHASIS IN BIOTECHNOLOGY

Upper Division Requirements in the Major
(49 Units)

1. Required Biology Courses (37 units)
   - BIOL 300 Cell Biology (4)
   - BIOL 301 Microbiology (4)
   - BIOL 302 Genetics (4)
   - BIOL 400 Molecular Biology (4)
   - BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
   - BIOL 404 Plant and Animal Tissue Culture (3)
   - BIOL 405 Biochemical Engineering (4)
   - BIOL 420 Cellular & Molecular Immunology (4)
   - BIOL 492 Internship (2-3)
   - BIOL 499 Senior Capstone in Biology (3)

2. Electives in Biology and Physics (12 units)
   - BIOL/315 Introduction to Biophysics (4)
   - PHYS
     - BIOL 403 Foundations of Structural Biology (4)
     - BIOL 408 Nanobiotechnology (3)
     - BIOL 421 Virology (3)
     - BIOL 422 Molecular Plant Physiology (4)
     - BIOL 423 Cellular & Molecular Neurobiology (3)
     - BIOL 424 Human Physiology (3)
     - BIOL 425 Human Genetics (3)
     - BIOL 428 Biology of Cancer (3)
     - BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)
     - MGT 471 Project Management (3)
     - BIOL 503 Biotechnology Law and Regulation (3)
     - MGT 471 Project Management (3)
     - BIOL 503 Biotechnology Law and Regulation (3)
### Required Supporting and Other GE Courses (63 Units)

1. **Chemistry** (14 units)
   - CHEM 121* General Chemistry I, GE-B1 (4)
   - CHEM 122 General Chemistry II, GE-B1 (4)
   - CHEM 311 Organic Chemistry I (3)
   - CHEM 318 Biological Chemistry (3)
   
   *(An organic chemistry taken at a community college may be accepted for the Biology major in lieu of CHEM 311)*

2. **Statistics, Mathematics and Computer Applications** (7 units)
   - BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)
   - MATH 150* Calculus I, GE-B3 (4)

3. **Other Required GE Courses in Categories A-E** (36 units)
   - Category A (9 units)
   - Category C (12 units)
   - Category D (12 units)
   - Category E (3 units)

4. **American Institutions Requirement** (6 units)

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### FOR EMPHASIS IN CELL AND MOLECULAR BIOLOGY

### Upper Division Requirements in the Major (40 Units)

1. **Required Biology Courses** (31 units)
   - BIOL 300 Cell Biology (4)
   - BIOL 301 Microbiology (4)
   - BIOL 302 Genetics (4)
   - BIOL 303 Evolutionary Biology (3)
   - BIOL 400 Molecular Biology (4)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 401</td>
<td>Biotechnology and Recombinant DNA Techniques</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 431*</td>
<td>Bioinformatics, GE-B2, B4, UDID</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 499</td>
<td>Senior Capstone in Biology</td>
<td>3</td>
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2. Electives in Biology (9 units)

*Select from the following list of courses:*

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<td>BIOL 402</td>
<td>Toxicology</td>
<td>3</td>
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<td>BIOL 403</td>
<td>Foundations of Structural Biology</td>
<td>4</td>
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<td>BIOL 404</td>
<td>Plant and Animal Tissue Culture</td>
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<td>BIOL 405</td>
<td>Biochemical Engineering</td>
<td>4</td>
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<tr>
<td>BIOL 408</td>
<td>Nanobiotechnology</td>
<td>3</td>
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<tr>
<td>BIOL / 416</td>
<td>Radiobiology and Radionuclides</td>
<td>3</td>
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<tr>
<td>PHYS</td>
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<tr>
<td>BIOL 420</td>
<td>Cellular &amp; Molecular Immunology</td>
<td>4</td>
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<td>BIOL 421</td>
<td>Virology</td>
<td>3</td>
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<td>BIOL 422</td>
<td>Molecular Plant Physiology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 423</td>
<td>Cellular &amp; Molecular Neurobiology</td>
<td>3</td>
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<td>BIOL 424</td>
<td>Human Physiology</td>
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<td>BIOL 427</td>
<td>Developmental Biology</td>
<td>4</td>
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<td>Biology of Cancer</td>
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<td>BIOL 432*</td>
<td>Principles of Epidemiology and Environmental Health, GE-B2, D, UDID</td>
<td>3</td>
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<tr>
<td>BIOL 433*</td>
<td>Ecology and the Environment, GE-B2, UDID</td>
<td>4</td>
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Required Supporting and Other GE Courses (72 Units)

1. Chemistry (minimum 15 units)

<table>
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<tr>
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<tr>
<td>CHEM 121*</td>
<td>General Chemistry I, GE-B1</td>
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<td>CHEM 122</td>
<td>General Chemistry II GE-B1</td>
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<td>CHEM 311</td>
<td>Organic Chemistry I</td>
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<td>CHEM 312</td>
<td>Organic Chemistry I Laboratory</td>
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<tr>
<td>CHEM 318</td>
<td>Biological Chemistry</td>
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2. Electives in Biology (9 units)

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<td>BIOL 425</td>
<td>Human Genetics</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 426</td>
<td>Hematology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 427</td>
<td>Developmental Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 428</td>
<td>Biology of Cancer</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 432*</td>
<td>Principles of Epidemiology and Environmental Health, GE-B2, D, UDID</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 433*</td>
<td>Ecology and the Environment, GE-B2, UDID</td>
<td>4</td>
</tr>
</tbody>
</table>

*No more than 2 units taken from the following:*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 492</td>
<td>Internship</td>
<td>2-3</td>
</tr>
<tr>
<td>BIOL 494</td>
<td>Independent Research</td>
<td>1-3</td>
</tr>
<tr>
<td>BIOL 497</td>
<td>Directed Study</td>
<td>1-3</td>
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</tbody>
</table>

Required Supporting and Other GE Courses (72 Units)

1. Chemistry (minimum 15 units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>CHEM 121*</td>
<td>General Chemistry I, GE-B1</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 122</td>
<td>General Chemistry II GE-B1</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 311</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 312</td>
<td>Organic Chemistry I Laboratory</td>
<td>1</td>
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</table>

*Select either*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 318</td>
<td>Biological Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Units</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>CHEM 314</td>
<td>Organic Chemistry II (3)</td>
<td></td>
</tr>
<tr>
<td>CHEM 315</td>
<td>Organic Chemistry II Laboratory (1)</td>
<td></td>
</tr>
</tbody>
</table>

*(A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315.)*

2. Physics (8 units)

*Select either*

- PHYS 100 Introduction to Physics I, GE-B1 (4)
- PHYS 101 Introduction to Physics II, GE-B1 (4)
- PHYS 200 General Physics I, GE-B1 (4)
- PHYS 201 General Physics II, GE-B1 (4)

3. Statistics and Mathematics (7 units)

- BIOL 203 Quantitative Methods for Biology, GE-B3, B4 (3)
- MATH 150 Calculus I, GE-B3 (4)

4. Other Required GE Courses in Categories A-E (36 units)

- Category A (9 units)
- Category C (12 units)
- Category D (12 units)
- Category E (3 units)

5. American Institutions Requirement (6 units)

FOR EMPHASIS IN CLINICAL LABORATORY SCIENCE

Additional Requirements in the Major (41 - 43 Units)

1. Required Biology Courses (37 units)

- BIOL 217 Medical Microbiology (4)
- BIOL 300 Cell Biology (4)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 302</td>
<td>Genetics (4)</td>
</tr>
<tr>
<td>BIOL 303</td>
<td>Evolutionary Biology (3)</td>
</tr>
<tr>
<td>BIOL 317</td>
<td>Parasitology (4)</td>
</tr>
<tr>
<td>BIOL 318</td>
<td>Medical Mycology (4)</td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Cellular and Molecular Immunology (4)</td>
</tr>
<tr>
<td>BIOL 421</td>
<td>Virology (3)</td>
</tr>
<tr>
<td>BIOL 426</td>
<td>Hematology (4)</td>
</tr>
<tr>
<td>BIOL 432*</td>
<td>Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)</td>
</tr>
</tbody>
</table>

2. Other Required Courses in Biology (4 - 6 units)

If one chooses to complete CHEM 318 and BIOL 203, one needs to complete a minimum of 6 units from the following courses. Otherwise, one needs to complete a minimum of 4 units from the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>BIOL 400</td>
<td>Molecular Biology (4)</td>
</tr>
<tr>
<td>BIOL 424</td>
<td>Human Physiology (3)</td>
</tr>
<tr>
<td>BIOL 425</td>
<td>Human Genetics (3)</td>
</tr>
</tbody>
</table>

Required Supporting and Other GE Courses (69-71 Units)

1. Chemistry (19 -20 units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 121*</td>
<td>General Chemistry I, GE-B1 (4)</td>
</tr>
<tr>
<td>CHEM 122</td>
<td>General Chemistry II GE-B1 (4)</td>
</tr>
<tr>
<td>CHEM 250</td>
<td>Quantitative Analysis (2)</td>
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<td>CHEM 251</td>
<td>Quantitative Analysis Laboratory (2)</td>
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<tr>
<td>CHEM 311</td>
<td>Organic Chemistry I (3)</td>
</tr>
<tr>
<td>CHEM 312</td>
<td>Organic Chemistry I Laboratory (1)</td>
</tr>
</tbody>
</table>

and

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 318</td>
<td>Biological Chemistry (3)</td>
</tr>
</tbody>
</table>

or

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 460</td>
<td>Biochemistry I (4)</td>
</tr>
</tbody>
</table>

(An organic chemistry course with laboratory taken with a laboratory at a community college may be accepted for the Biology major in lieu of CHEM 311 and 312.)

2. Physics (8 units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 100</td>
<td>Introduction to Physics I, GE-B1 (4)</td>
</tr>
<tr>
<td>PHYS 101</td>
<td>Introduction to Physics II, GE-B1 (4)</td>
</tr>
</tbody>
</table>
FOR EMPHASIS IN ECOLOGY, EVOLUTION AND ORGANISMAL BIOLOGY

Upper Division Requirements in the Major
(42-44 Units)

1. Required Core Courses (26 units)
   BIOL 301 Microbiology (4)
   BIOL 302 Genetics (4)
   BIOL 303 Evolutionary Biology (3)
   BIOL 311 Plant Biology and Ecology (4)
   and
   BIOL 310 Vertebrate Biology (4)
   or
   BIOL 316 Invertebrate Zoology (4)
   and
   BIOL 433* Ecology and the Environment, GE- B2, UDID (4)
   BIOL 499 Senior Capstone in Biology (3)

2. Ecology/Evolution
   Select two courses from the following list (6-7 units):
   BIOL/ 313 Conservation Biology (4)

3. Statistics and Mathematics (3 - 4 units)
   Select one of the following courses:
   BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)
   MATH 150* Calculus I, GE-B3 (4)

4. Other Required GE Courses in Categories A-E (33 units)
   Category A (9 units)
   For A3, recommend MATH 230 Logic and Mathematical Reasoning (3)
   Category C (12 units)
   Category D (9 units)
   Category E (3 units)

5. American Institutions Requirement (6)

(Courses with * are double-counted toward GE credits.)

FOR EMPHASIS IN ECOLOGY, EVOLUTION AND ORGANISMAL BIOLOGY

Upper Division Requirements in the Major
(42-44 Units)

1. Required Core Courses (26 units)
   BIOL 301 Microbiology (4)
   BIOL 302 Genetics (4)
   BIOL 303 Evolutionary Biology (3)
   BIOL 311 Plant Biology and Ecology (4)
   and
   BIOL 310 Vertebrate Biology (4)
   or
   BIOL 316 Invertebrate Zoology (4)
   and
   BIOL 433* Ecology and the Environment, GE- B2, UDID (4)
   BIOL 499 Senior Capstone in Biology (3)

2. Ecology/Evolution
   Select two courses from the following list (6-7 units):
   BIOL/ 313 Conservation Biology (4)
3. Organismal Biology

Select one course from the following list (4 units):

- **BIOL 310** Vertebrate Biology (4) *(if not taken as part of core)*
- **BIOL 312** Marine Biology (4)
- **BIOL 316** Invertebrate Zoology (4) *(if not taken as part of core)*
- **BIOL 317** Parasitology (4)
- **BIOL 450** Ichthyology: The Biology of Fishes (4)
- **BIOL 451** Ornithology (4)

4. Physiology/Developmental/Molecular Biology

Select one course from the following list (3-4 units):

- **BIOL 300** Cell Biology (4)
- **BIOL 304** Comparative Animal Physiology (3)
- **BIOL 400** Molecular Biology (4)
- **BIOL 422** Molecular Plant Physiology (4)
- **BIOL 427** Developmental Biology (4)

5. Cross-Disciplinary

Select one course from the following list (3-4 units):

- **CHEM 301** Environmental Chemistry (3)
- **GEOL 321** Environmental Geology, GE-B1 (4)
- **ESRM 328** Introduction to Geographic Information Systems (3)

### Required Supporting and Other GE Courses (63 Units)

1. Required Supporting Courses (21 units)

   - **CHEM 121** General Chemistry I, GE-B1 (4)
   - **CHEM 122** General Chemistry II, GE-B1 (4)
   - **CHEM 311** Organic Chemistry I (3)
   - **GEOL 122** Historical Geology, GE-B1 (3)
   - **BIOL 203** Quantitative Methods for Biology, GE-B3, B4 (3)
   - **MATH 150** Calculus I, GE-B3 (4)
2. Other Required GE Courses in Categories A-E (36 units)
   Category A (9 units)
   Category C (12 units)
   Category D (12 units)
   Category E (3 units)

3. American Institutions Requirement (6 units)

Electives in Any Discipline (4-7 units)

FOR EMPHASIS IN MEDICAL IMAGING

Additional Lower Division Requirements in the Major (8 Units)
BIOL 210 Human Anatomy and Physiology I (4)
BIOL 211 Human Anatomy and Physiology II (4)

Upper Division Requirements in the Major (38 Units)
1. Required Biology and Physics Courses (30 units)
   BIOL 300 Cell Biology (4)
   BIOL 301 Microbiology (4)
   BIOL 302 Genetics (4)
   BIOL 400 Molecular Biology (4)
   BIOL/PHYS 416 Radiobiology and Radionuclides (3)
   PHYS 434* Introduction to Biomedical Imaging,
   HLTH/PHYS GE-B1, E, UDID (4)
   BIOL 464 Biomedical Instrumentation (4)
   PHYS 499 Senior Capstone in Biology (3)

5/25/2004 cp
2. Electives in Biology and Physics (8 units)

Select from the following list of courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL/PHYS 315</td>
<td>Introduction to Biophysics</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 401</td>
<td>Biotechnology and Recombinant DNA Techniques</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Cellular &amp; Molecular Immunology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 421</td>
<td>Virology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 423</td>
<td>Cellular &amp; Molecular Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 424</td>
<td>Human Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 425</td>
<td>Human Genetics</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 427</td>
<td>Developmental Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 428</td>
<td>Biology of Cancer</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 431*</td>
<td>Bioinformatics, GE-B2, B4, UDID</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 432*</td>
<td>Principles of Epidemiology and Environmental Health, GE-B2, D, UDID</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 433*</td>
<td>Ecology and the Environment, GE-B2, UDID</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 445*</td>
<td>Image Analysis and Pattern Recognition, GE-B1, B4, UDID</td>
<td>3</td>
</tr>
</tbody>
</table>

No more than 2 units taken from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 492</td>
<td>Physics Internship</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 494</td>
<td>Independent Research</td>
<td>1-3</td>
</tr>
<tr>
<td>PHYS 492</td>
<td>Physics Internship</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 494</td>
<td>Independent Research</td>
<td>1-3</td>
</tr>
<tr>
<td>BIOL 497</td>
<td>Directed Study</td>
<td>1-3</td>
</tr>
<tr>
<td>PHYS 497</td>
<td>Directed Study</td>
<td>1-3</td>
</tr>
</tbody>
</table>

Required Supporting and Other GE Courses (66 Units)

1. Chemistry (15 units)

<table>
<thead>
<tr>
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<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 121*</td>
<td>General Chemistry I, GE-B1</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 122</td>
<td>General Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 311</td>
<td>Organic Chemistry I</td>
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</tr>
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<td>CHEM 312</td>
<td>Organic Chemistry I Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 318</td>
<td>Biological Chemistry</td>
<td>3</td>
</tr>
</tbody>
</table>

(An organic chemistry I-equivalent course with laboratory taken at a community college)

5/25/2004 cp
2. Mathematics (4 units)
   MATH 150* Calculus I, GE-B3 (4)

3. Physics (8 units)
   Select either
   PHYS 100 Introduction to Physics I, GE-B1 (4)
   and
   PHYS 101 Introduction to Physics II, GE-B1 (4)
   or
   PHYS 200 General Physics I, GE-B1 (4)
   and
   PHYS 201 General Physics II, GE-B1 (4)

4. Other Required GE Courses in Categories A-D
   (33 units)
   Category A (9 units)
   Category C (12 units)
   Category D (12 units)
   Category E- covered by a required GE course for the degree program

5. American Institutions Requirement (6 units)

(Courses with * are double-counted toward GE credits.)

REQUIREMENTS FOR THE BACHELOR OF ARTS DEGREE IN BIOLOGY (120 UNITS)

Common Lower Division Requirements for All Emphases (8 Units)

BIOL 200* Principles of Organismal and Population Biology, GE-B2 (4)
BIOL 201 Principles of Cell and Molecular Biology (4)
## Upper Division Requirements in the Major

### (36-38 Units)

1. **Required Biology Core Courses (26 units)**
   - BIOL 301 Microbiology (4)
   - BIOL 302 Genetics (4)
   - BIOL 303 Evolutionary Biology (3)
   - BIOL 311 Plant Biology and Ecology (4)
   - BIOL 316 Invertebrate Zoology (4)
   - BIOL 433* Ecology and the Environment, GE-B2, UDID (4)
   - BIOL 499 Senior Capstone (3)

2. **Ecology/Evolution**
   - Select one course from the following list (3-4 units):
     - BIOL/313 Conservation Biology (4)
     - ESRM
     - BIOL 406 Evolutionary Biogeography (3)
     - BIOL 407 Behavioral Ecology (3)

3. **Organismal Biology**
   - Select one course from the following list (4 units):
     - BIOL 310 Vertebrate Biology (4) *(if not taken as part of core)*
     - BIOL 312 Marine Biology (4)
     - BIOL 316 Invertebrate Zoology (4) *(if not taken as part of core)*
     - BIOL 317 Parasitology (4)
     - BIOL 450 Ichthyology: The Biology of Fishes (4)
     - BIOL 451 Ornithology (4)

4. **Physiology/Developmental/Molecular Biology**
   - Select one course from the following list (3-4 units)
     - BIOL 300 Cell Biology (4)
     - BIOL 304 Comparative Animal Physiology (3)

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5/25/2004 cp
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 400</td>
<td>Molecular Biology</td>
<td>(4)</td>
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<tr>
<td>BIOL 422</td>
<td>Molecular Plant Physiology</td>
<td>(4)</td>
</tr>
<tr>
<td>BIOL 427</td>
<td>Developmental Biology</td>
<td>(4)</td>
</tr>
</tbody>
</table>

Required Supporting and Other GE Courses (56 Units)

1. Required Supporting Courses (14 units)
   - CHEM 121* General Chemistry I, GE-B1 (4)
   - CHEM 122 General Chemistry II, GE-B2 (4)
   - GEOL 122* Historical Geology, GE-B1 (3)
   - BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)

2. Other Required GE Courses in Categories A-E (36 units)
   - Category A (9 units)
   - Category C (12 units)
   - Category D (12 units)
   - Category E (3 units)

3. American Institutions Requirement (6 units)

Electives in Any Discipline (18-20 units)

FOR EMPHASIS IN GENERAL BIOLOGY

Upper Division Requirements in the Major (37 Units)

1. Required Biology Courses (25 units)
   - BIOL 300 Cell Biology (4)
   - BIOL 302 Genetics (4)
   - BIOL 303 Evolutionary Biology (3)
   - BIOL 304 Comparative Animal Physiology (3)
   - BIOL 400 Molecular Biology (4)
2. Electives in Biology (12 units)

Select at least three courses from the following list, one of which must be a lab course.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>BIOL 301</td>
<td>Microbiology</td>
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<td>BIOL 310</td>
<td>Vertebrate Biology</td>
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<td>BIOL 311</td>
<td>Plant Biology and Ecology</td>
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<td>Marine Biology</td>
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<td>BIOL 313</td>
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<td>ESRM</td>
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<td>BIOL 316</td>
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<td>BIOL 317</td>
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<tr>
<td>BIOL 401</td>
<td>Biotechnology and Recombinant DNA Techniques</td>
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<td>BIOL 402</td>
<td>Toxicology</td>
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<td>BIOL 403</td>
<td>Foundations of Structural Biology</td>
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<tr>
<td>BIOL 404</td>
<td>Plant and Animal Tissue Culture</td>
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<td>BIOL 405</td>
<td>Biochemical Engineering</td>
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<td>BIOL 406</td>
<td>Evolutionary Biogeography</td>
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<td>BIOL 407</td>
<td>Behavioral Ecology</td>
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<td>BIOL 408</td>
<td>Nanobiotechnology</td>
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<td>BIOL 420</td>
<td>Cellular &amp; Molecular Immunology</td>
<td>4</td>
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<tr>
<td>BIOL 421</td>
<td>Virology</td>
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<tr>
<td>BIOL 425</td>
<td>Human Genetics</td>
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<td>4</td>
</tr>
<tr>
<td>BIOL 450</td>
<td>Ichthyology: The Biology of Fishes</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 451</td>
<td>Ornithology</td>
<td>4</td>
</tr>
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No more than 2 units taken from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Internship</td>
<td>2-3</td>
</tr>
<tr>
<td>BIOL 494</td>
<td>Independent Research</td>
<td>1-3</td>
</tr>
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</table>

Required Supporting and Other GE Courses (53-54 Units)

1. Chemistry (8 units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 121*</td>
<td>General Chemistry I, GE-B1</td>
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</tr>
<tr>
<td>CHEM 122</td>
<td>General Chemistry II, GE-B1</td>
<td>4</td>
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</tbody>
</table>

2. Mathematics and Statistics (3-4 units)

Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 203*</td>
<td>Quantitative Methods for Biology, GE-B3, B4</td>
<td>3</td>
</tr>
<tr>
<td>MATH 105</td>
<td>Pre-Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 150*</td>
<td>Calculus I, GE-B3</td>
<td>4</td>
</tr>
</tbody>
</table>

3. Other Required GE Courses in Categories A-E (36 units)

Category A (9 units)

For A3, recommend MATH 230 Logic and Mathematical Reasoning (3)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category C</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Category D</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Category E</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

4. American Institutions Requirements (6 units)

Electives in Any Discipline (21-22 units)
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 121*</td>
<td>General Chemistry I, GE-B1</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 122</td>
<td>General Chemistry II, GE-B1</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 203*</td>
<td>Quantitative Methods for Biology, GE-B3, B4</td>
<td>3</td>
</tr>
<tr>
<td>MATH 105</td>
<td>Pre-Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 150*</td>
<td>Calculus I, GE-B3</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 300</td>
<td>Cell Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 302</td>
<td>Genetics</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 304</td>
<td>Comparative Animal Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 400</td>
<td>Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 433*</td>
<td>Ecology and the Environment, GE-B2, UDID</td>
<td>4</td>
</tr>
</tbody>
</table>

### FOR EMPHASIS IN PRE-PROFESSIONAL STUDIES

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 300</td>
<td>Cell Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 302</td>
<td>Genetics</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 304</td>
<td>Comparative Animal Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 400</td>
<td>Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 303</td>
<td>Evolutionary Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 433*</td>
<td>Ecology and the Environment, GE-B2, UDID</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 499</td>
<td>Senior Capstone in Biology</td>
<td>3</td>
</tr>
</tbody>
</table>
2. Electives in Biology (10-11 units)

Select a minimum of 10-11 units of biology courses from 300 and 400 levels, one of which must be a lab course. Biology courses numbered from 326 to 345 are counted toward GE credits only and they are not counted towards the 10-11 units of electives. The following courses can be taken as biology electives. However, no more than 2 units taken from the following can be counted towards the 10-11 units of electives:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 492</td>
<td>Internship</td>
<td>2-3</td>
</tr>
<tr>
<td>BIOL 494</td>
<td>Independent Research</td>
<td>1-3</td>
</tr>
<tr>
<td>BIOL 497</td>
<td>Directed Study</td>
<td>1-3</td>
</tr>
</tbody>
</table>

Required Supporting and Other GE Courses (69-70 Units)

1. Chemistry (16 units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 121*</td>
<td>General Chemistry I, GE-B1</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 122</td>
<td>General Chemistry II GE-B1</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 311</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 312</td>
<td>Organic Chemistry I Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 314</td>
<td>Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 315</td>
<td>Organic Chemistry II Laboratory</td>
<td>1</td>
</tr>
</tbody>
</table>

(A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315)

2. Mathematics and Statistics (3-4 units)

Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 203*</td>
<td>Quantitative Methods for Biology, GE-B3, B4, UDID</td>
<td>3</td>
</tr>
<tr>
<td>MATH 150*</td>
<td>Calculus I, GE-B3</td>
<td>4</td>
</tr>
</tbody>
</table>

(Check with professional schools or pre-professional advisor for specific requirements in this category.)

3. Physics (8 units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 100</td>
<td>Introduction to Physics I, GE-B1</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 101</td>
<td>Introduction to Physics II, GE-B1</td>
<td>4</td>
</tr>
</tbody>
</table>

4. Other Required GE Courses in Categories A-E (36 units)
### Required Supporting and Other GE Courses

(69-70 Units)

1. **Chemistry (16 units)**
   - **CHEM 121** General Chemistry I, GE-B1 (4)
   - **CHEM 122** General Chemistry II GE-B1 (4)
   - **CHEM 311** Organic Chemistry I (3)
   - **CHEM 312** Organic Chemistry I Laboratory (1)
   - **CHEM 314** Organic Chemistry II (3)
   - **CHEM 315** Organic Chemistry II Laboratory (1)
   
   *(A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315)*

2. **Mathematics and Statistics (3-4 units)**
   - **Select one of the following:**
     - **BIOL 203** Quantitative Methods for Biology, GE-B3, B4 (3)
     - **MATH 150** Calculus I, GE-B3 (4)
   
   *(Check with professional schools or pre-professional advisor for specific requirements in this category.)*

3. **Physics (8 units)**
   - **PHYS 100** Introduction to Physics I, GE-B1 (4)
   - **PHYS 101** Introduction to Physics II, GE-B1 (4)

4. **Other Required GE Courses in Categories A-E (36 units)**
   - **Category A** (9 units)
   - **Category C** (12 units)
   - **Category D** (12 units)
   - **Category E** (3 units)

5. **American Institutions Requirements (6 units)**

**FOR EMPHASIS IN SUBJECT MATTER PREPARATION IN**

### Category A (9 units) -
- For A3, recommend **MATH 230 Logic and Mathematical Reasoning (3)**
  - **Category C** (12 units)
  - **Category D** (12 units)
  - **Category E** (3 units)

**5. American Institutions Requirements (6 units)**

**Electives in Any Discipline (10-11 Units)**
### TEACHING BIOLOGY

#### Upper Division Requirements in the Major (36 Units)

1. Required Biology Courses (24 units)
   
   - BIOL 300 Cell Biology (4)
   - BIOL 302 Genetics (4)
   - BIOL 303 Evolutionary Biology (3)
   - BIOL 304 Comparative Animal Physiology (3)
   - BIOL 335* The Biosphere, GE-B2, UDID (3)
   - BIOL 433* Ecology and the Environment, GE-B2, UDID (4)
   - BIOL 499 Senior Capstone in Biology (3)

2. Electives in Biology (12 units)
   
   Select at least three courses from the following list, one of which must be a lab course.
   
   - BIOL 301 Microbiology (4)
   - BIOL 310 Vertebrate Biology (4)
   - BIOL 311 Plant Biology and Ecology (4)
   - BIOL 312 Marine Biology (4)
   - BIOL/313 Conservation Biology (4)
   - ESRM
   - BIOL 316 Invertebrate Zoology (4)
   - BIOL 317 Parasitology (4)
   - BIOL 400 Molecular Biology (4)
   - BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
   - BIOL 402 Toxicology (3)
   - BIOL 403 Foundations of Structural Biology (4)
   - BIOL 404 Plant and Animal Tissue Culture (3)
   - BIOL 405 Biochemical Engineering (4)
   - BIOL 406 Evolutionary Biogeography (3)
   - BIOL 407 Behavioral Ecology (3)
   - BIOL 408 Nanobiotechnology (3)
   - BIOL 420 Cellular & Molecular Immunology (4)
   - BIOL 421 Virology (3)
   - BIOL 422 Molecular Plant Physiology (4)
   - BIOL 423 Cellular & Molecular Neurobiology (3)
   - BIOL 424 Human Physiology (3)

### FOR EMPHASIS IN SUBJECT MATTER PREPARATION IN TEACHING BIOLOGY (PENDING CCTC APPROVAL)

#### Upper Division Requirements in the Major (36 Units)

1. Required Biology Courses (24 units)
   
   - BIOL 300 Cell Biology (4)
   - BIOL 302 Genetics (4)
   - BIOL 303 Evolutionary Biology (3)
   - BIOL 304 Comparative Animal Physiology (3)
   - BIOL 335* The Biosphere, GE-B2, UDID (3)
   - BIOL 433* Ecology and the Environment, GE-B2, UDID (4)
   - BIOL 499 Senior Capstone in Biology (3)

2. Electives in Biology (12 units)
   
   Select a minimum of 12 units of biology courses from 300 and 400 levels, one of which must be a lab course. Biology courses numbered from 326 to 345, with the exception of BIOL 335 for this emphasis, are counted toward GE credits only and they are not counted towards the 12 units of electives. The following courses can be taken as biology electives. However, no more than 2 units taken from the following can be counted towards the 12 units of electives:
   
   - BIOL 492 Internship (2-3)
   - BIOL 494 Independent Research (1-3)
   - BIOL 497 Directed Study (1-3)

#### Required Supporting and Other GE Courses (76 units)

1. Required Education Course (3 units)
   
   - EDUC 330* Introduction to Secondary Schooling, GE-D, UDID (3)

2. Mathematics and Statistics (7 units)
   
   - BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)
   - MATH 105 Pre-Calculus (4)

3. Physical Sciences (24 units)
BIOL 425  Human Genetics (3)
BIOL 427  Developmental Biology (4)
BIOL 428  Biology of Cancer (3)
BIOL 431*  Bioinformatics, GE-B2, B4, UDID (4)
BIOL 432*  Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)
BIOL 450  Ichthyology: The Biology of Fishes (4)
BIOL 451  Ornithology (4)

No more than 2 units taken from the following:
BIOL 492  Internship (2-3)
BIOL 494  Independent Research (1-3)
BIOL 497  Directed Study (1-3)

Required Supporting and Other GE Courses
(76 units)
1. Required Education Course (3 units)
   EDUC 330* Introduction to Secondary Schooling, GE-D, UDID (3)

2. Mathematics and Statistics (7 units)
   BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)
   and
   MATH 105 Pre-Calculus (4)
   or
   MATH 150* Calculus I, GE-B3 (4)

3. Physical Sciences (24 units)
   CHEM 121* General Chemistry I, GE-B1 (4)
   CHEM 122  General Chemistry II, GE-B1 (4)
   GEOL 121  Physical Geology (4)
   PHYS 100  Introduction to Physics I, GE-B1 (4)
   PHYS 101  Introduction to Physics II, GE-B1 (4)
   PHYS/105 Introduction to the Solar System, GE-ASTR B1 (4)

4. Other Required GE Courses in Categories A-E (36 units)
   Category A (9 units)
      For A3, recommend MATH 230 Logic and Mathematical Reasoning (3)
   Category C (12 units)
   Category D (12 units)
   Category E (3 units)

5. American Institutions Requirements (6 units)

(Courses with * are double-counted toward GE credits.)
5. American Institutions Requirements (6 units)

(Courses with * are double-counted toward GE credits.)

REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE IN BIOTECHNOLOGY & BIOINFORMATICS (33-34 UNITS)

PROGRAM DESCRIPTION
The Master of Science in Biotechnology and Bioinformatics is a professional degree program designed to meet the needs of biotechnology industry and related public and private agencies and organizations. The program combines rigorous scientific training in interdisciplinary areas in biotechnology and bioinformatics with course work and experience in business management and regulatory affairs. The program includes a set of core courses with two emphases to choose from: biotechnology and bioinformatics, and several elective courses.

Biotechnology is centered in the laboratory and employs sophisticated molecular biology techniques for applications in human and animal health, agriculture, environment, and specialty biochemical manufacturing. In the next century, the major driving force for biotechnology will be the strategic use of the data derived from large-scale genome sequencing projects. Bioinformatics turns raw data from genome sequencing and new experimental methodologies such as microarrays and proteomics into useful and accessible information about gene function, protein structure, molecular evolution, drug targets and disease mechanisms using computational analyses, statistics, and pattern recognition. Our approach also includes team projects drawn from biotechnology industries to focus on real-world problems and applications of biological and computational sciences and to inculcate interpersonal as well as problem-solving skills using multiple perspectives.

Graduates from this program will develop analytical, managerial and interpersonal skills along with sophisticated expertise in biotechnology and bioinformatics. They will be ready to make immediate contributions to scientific research and development, management in biotechnological, biomedical and pharmaceutical industries, biotechnology law and regulations, governmental or environmental...
agencies, research institutes, consulting firms, research and clinical laboratories, private and public health organizations, or education.

**ADMISSION REQUIREMENTS**

1. Applicants must have a BS/BA degree in Biology, Computer Science, Chemistry, Biochemistry, or Mathematics. Alternatively, applicants with a BA/BS degree in any field and equivalent work experiences in one of the above fields may be granted conditional admission, and they must fulfill all conditional requirements before they can be fully classified.

2. Applicants seeking admission to the professional MS in Biotechnology and Bioinformatics program must be officially accepted into the CSUCI academic program.

3. Applicants must declare themselves as graduate students in the professional MS degree program in Biotechnology and Bioinformatics.

4. Applicants will be evaluated by the program admissions committee which will consider the applicants in the context of the total applicant pool using our general admission standards. The following materials are required for our evaluation and admission process:
   - Applicants must submit their transcript from their undergraduate institution, Graduate Record Examinations (GRE) General Test scores or the Medical College Admission Test (MCAT) scores.
   - Applicants who have received their undergraduate degrees from a university where English is not the language of instruction, or have studied fewer than two years at a university where instruction is in English, must submit their Test of English as a Foreign Language (TOEFL) scores for evaluation.
   - Applicants must submit a one page “Statement of Purpose” and two letters of recommendations from people able to judge the applicant’s capacity for both academic and professional success.

**DEGREE REQUIREMENTS**

<table>
<thead>
<tr>
<th>Common Core Courses (16 units)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BINF 500</strong> DNA &amp; Protein Sequence Analysis (3)</td>
</tr>
<tr>
<td><strong>BIOL 502</strong> Techniques in Genomics &amp; Proteomics (2)</td>
</tr>
<tr>
<td><strong>BIOL 503</strong> Biotechnology Law and Regulation (3)</td>
</tr>
<tr>
<td><strong>MGT 471</strong> Project Management (3)</td>
</tr>
<tr>
<td><strong>BIOL 600</strong> Team Project (4)</td>
</tr>
<tr>
<td><strong>BIOL 601</strong> Seminar Series in Biotechnology and Bioinformatics (1)</td>
</tr>
</tbody>
</table>

development, management in biotechnological, biomedical and pharmaceutical industries, biotechnology law and regulations, governmental or environmental agencies, research institutes, consulting firms, research and clinical laboratories, private and public health organizations, or education.

**ADMISSION REQUIREMENTS**

1. Applicants must have a BS/BA degree in Biology, Computer Science, Chemistry, Biochemistry, or Mathematics. Alternatively, applicants with a BA/BS degree in any field and equivalent work experiences in one of the above fields may be granted conditional admission, and they must fulfill all conditional requirements before they can be fully classified.

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**DEGREE REQUIREMENTS**

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<td><strong>BINF 500</strong> DNA &amp; Protein Sequence Analysis (3)</td>
</tr>
<tr>
<td><strong>BIOL 502</strong> Techniques in Genomics &amp; Proteomics (2)</td>
</tr>
<tr>
<td><strong>BIOL 503</strong> Biotechnology Law and Regulation (3)</td>
</tr>
<tr>
<td><strong>MGT 471</strong> Project Management (3)</td>
</tr>
<tr>
<td><strong>BIOL 600</strong> Team Project (4)</td>
</tr>
</tbody>
</table>
FOR BIOTECHNOLOGY EMPHASIS (17 UNITS)

Required Courses (7 units)
- BIOL 504 Molecular Cell Biology (3)
- BIOL 505 Molecular Structure (4)

Electives (10 units)
A minimum of 10 units chosen from the following courses and/or from the elective courses under the Bioinformatics Emphasis:
- BIOL 506 Molecular Evolution (4)
- BIOL 507 Pharmacogenomics and Pharmacoproteomics (3)
- BIOL 508 Advanced Immunology (4)
- BIOL 509 Plant Biotechnology (4)
- MGT 421 Human Resource Management (3)
- BIOL 490 Special Topics (1-3)

FOR BIOINFORMATICS EMPHASIS (18 UNITS)

Required Courses (12 units)
- BINF 501 Biological Informatics (3)
- BINF 510 Database Systems for Bioinformatics (3)
- BINF 511 Computational Genomics (3)
- BINF 513 Programming for Bioinformatics (3)

Electives (6 units)
A minimum of two courses chosen from the following and/or from the elective courses under the Biotechnology Emphasis, with at least one course in the BINF category:
- BINF 512 Algorithms for Bioinformatics (3)
- BINF 514 Statistical Methods in Computational Biology (3)
- PHYS 445 Image Analysis & Pattern Recognition (3)
- COMP/MATH GE-B1, B4, UDID (3)
- MGT 421 Human Resource Management (3)
- BIOL 490 Special Topics (1-3)

FOR BIOTECHNOLOGY EMPHASIS (17 UNITS)

Required Courses (7 units)
- BIOL 504 Molecular Cell Biology (3)
- BIOL 505 Molecular Structure (4)

Electives (10 units)
A minimum of 10 units chosen from the following courses and/or from the elective courses under the Bioinformatics Emphasis:
- BIOL 506 Molecular Evolution (4)
- BIOL 507 Pharmacogenomics and Pharmacoproteomics (3)
- BIOL 508 Advanced Immunology (4)
- BIOL 509 Plant Biotechnology (4)
- MGT 421 Human Resource Management (3)
- BIOL 490 Special Topics (1-3)

FOR BIOINFORMATICS EMPHASIS (18 UNITS)

Required Courses (12 units)
- BINF 501 Biological Informatics (3)
- BINF 510 Database Systems for Bioinformatics (3)
- BINF 511 Computational Genomics (3)
- BINF 513 Programming for Bioinformatics (3)

Electives (6 units)
A minimum of two courses chosen from the following and/or from the elective courses under the Biotechnology Emphasis, with at least one course in the BINF category:
- BINF 512 Algorithms for Bioinformatics (3)
- BINF 514 Statistical Methods in Computational Biology (3)
- PHYS 445 Image Analysis & Pattern Recognition (3)
- COMP/MATH GE-B1, B4, UDID (3)
- MGT 421 Human Resource Management (3)
- BIOL 490 Special Topics (1-3)
REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE IN BIOTECHNOLOGY AND MASTER OF BUSINESS ADMINISTRATION (71 UNITS*)

*Assumes that at least one set of the Foundation Courses listed below has been completed in a business or science undergraduate degree program.

PROGRAM DESCRIPTION
The Master of Science in Biotechnology and Master of Business Administration is a dual professional degree program designed to meet the needs of biotechnology industry and related public and private agencies and organizations. The program combines rigorous scientific training in biotechnology with graduate course work and experience in business management and regulatory affairs. The program includes the foundation courses for the dual degree program, a set of graduate level core courses in both biotechnology and business, and several elective courses.

Our approach includes team projects drawn from biotechnology industries to focus on real-world problems and applications of biological sciences and business. We approach interpersonal skills and problem-solving skills from multiple perspectives.

ADMISSION REQUIREMENTS
1. Applicants must have a BS/BA. degree in Biology, Chemistry, Biochemistry, or Business/ Economics related discipline. Alternatively, applicants with a BA/BS degree in any field and equivalent work experiences in one of the above fields may be admitted and must fulfill the foundation course requirements before taking the core courses and electives in the degree program.
2. Applicants seeking admission to the dual degree program must be officially accepted into CSUCI as graduate students.
3. Applicants must declare themselves as graduate students in the dual degree program.
4. Applicants will be evaluated by the program admissions committee which will consider the applicants in the context of the total applicant pool using our general admission standards. The following materials are required for our evaluation and admission process:
   • Applicants must submit their transcript(s) from their undergraduate institution(s) and Graduate Record Examinations (GRE) General Test scores.
   • Applicants who have received their undergraduate degrees from a university
where English is not the language of instruction, or have studied fewer than two years at a university where instruction is in English, must submit their Test of English as a Foreign Language (TOEFL) scores.  
• Applicants must submit a one page “Statement of Purpose” and two letters of recommendations from people able to judge the applicant’s capacity for both academic and professional success.

DEGREE REQUIREMENTS

Required Foundation Courses (16 Units)

1. Required Foundation Courses in Biology and Chemistry for students without a B.S. in Biology or Chemistry (16 units)
   CHEM 110 Chemistry of Life (4)  
   BIOL 201 Principles of Cell and Molecular Biology (4)  
   BIOL 300 Cell Biology (4)  
   BIOL 400 Molecular Biology (4)

2. Required Foundation Courses in Business/Economics for students without a BS/BA in Business or Economics or a related discipline (16 units)
   BUS 500 Economics for Managers (3)  
   BUS 502 Quantitative Methods for Decision-Making (3)  
   BUS 504 Introduction to Accounting and Finance (4)  
   BUS 506 Principles of Management and Marketing (3)  
   BUS 508 Business Ethics and Law (3)

CORE COURSES

Common Required Courses in the Dual Degree Program (9 Units)
   MGT 471 Project Management (3)  
   BIOL/610 Capstone Project for MS/MBA Dual  
   BUS Degree (6)

Required Courses in the Master of Science in Biotechnology (22 Units)

1. Required Core Courses (15 units)
   BINF 500 DNA & Protein Sequence Analysis (3)  
   BIOL 502 Techniques in Genomics/Proteomics (2)
REQUIREMENTS FOR THE MINOR IN BIOLOGY (21 UNITS)

LOWER DIVISION REQUIREMENTS (8 UNITS)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 200*</td>
<td>Principles of Organismal and Population Biology, GE-B2 (4)</td>
</tr>
<tr>
<td>BIOL 201</td>
<td>Principles of Cell and Molecular Biology, GE-B2 (4)</td>
</tr>
</tbody>
</table>

Required Courses in the Master of Business Administration (24 Units)

1. Required Core Courses (18 units)
   - BUS 510 High Performance Management (3)
   - BUS 520 Strategy and Leadership (3)
   - BUS 530 Managing Business Operations (3)
   - BUS 540 Financial Reporting and Analysis (3)
   - BUS 550 The Contemporary Firm (3)
   - BUS 560 The Entrepreneurial Manager (3)

2. Elective Courses (6 units)
   - Double-counted courses:
     - BINF 500 DNA & Protein Sequence Analysis (3)
     - BIOL 503 Biotechnology Law and Regulation (3)
### UPPER DIVISION REQUIREMENTS (13 UNITS)

1. Biology (8 units)
   - BIOL 300 Cell Biology (4)
   - BIOL 302 Genetics (4)

2. Biology Electives (5 units)
   A minimum of 5 units of 300-400 level biology courses, with no more than one course selected from BIOL 331-345.

### REQUIREMENTS FOR THE CERTIFICATE IN BIOTECHNOLOGY (25-27 UNITS)

(For students with a B.S. degree in biology pursuing a certificate in biotechnology)

1. B.S. degree in biology (may be concurrent);

2. Completion of the following courses with C or better grades (16-17 units):
   - BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
   - BIOL 420 Cellular & Molecular Immunology (4)
   - BIOL 431 Bioinformatics (4)
   - CHEM 318 Biological Chemistry (3)
   - CHEM 460 Biochemistry I (4)

   or
   - CHEM 460 Biochemistry I (4)

3. Complete another 4 units of upper-division biology course in consultation with the program (4);

4. Complete BIOL 492 Internship (2-3 units);

5. Complete BIOL 499 Senior Capstone in Biology (3 units);

6. Approval by the Biology program.

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### REQUIREMENTS FOR THE CERTIFICATE IN BIOTECHNOLOGY (25-27 UNITS)

(For students with a B.S. degree in biology pursuing a certificate in biotechnology)

1. B.S. degree in biology (may be concurrent);

2. Completion of the following courses with C or better grades (16-17 units):
   - BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
   - BIOL 420 Cellular & Molecular Immunology (4)
   - BIOL 431 Bioinformatics (4)
   - CHEM 318 Biological Chemistry (3)
   - CHEM 460 Biochemistry I (4)

   or
   - CHEM 460 Biochemistry I (4)

3. Complete another 4 units of upper-division biology course in consultation with the program (4);

4. Complete BIOL 492 Internship (2-3 units);

5. Complete BIOL 499 Senior Capstone in Biology (3 units);

6. Approval by the Biology program.
**SUMMARY OF CHANGES**

1. We are proposing to offer a new Emphasis in Clinical Laboratory Science within the BS in Biology program. This emphasis takes 120 units to complete. All, except two, courses supporting this emphasis are already being offered by various programs in biology, chemistry, physics and mathematics.

2. We are proposing to add a recommended course, MATH 230 Logic and Mathematics Reasoning, for A3 Category of GE requirements for all the undergraduate biology programs.

3. We included a course, BIOL 510 Tissue Culture Techniques and Stem Cell Technology that is required for the MS Biotechnology/MBA dual degree program, as an elective course for the MS Biotechnology and Bioinformatics program.

4. We have deleted the long list of elective courses in biology in several emphases and replaced it with a general statement to shorten the program description.

**JUSTIFICATION**

1. In August, 2007, a research report was completed by Continuing and Professional Education Program. The research assessed the occupational projections in California and the region. It indicates that there is an immediate and long-term need in healthcare-related educational programming in this region. Clinical laboratory science (CLS) is one of the fields identified in the report. The average age of professionals working in the field of CLS is 53. There is also a strong need in public health professionals who are trained to deal with epidemics and potential biological disasters, man-made or other wise, caused by microorganisms. In order to become a licensed CLS or public health microbiologist and be able to work in hospitals/clinics and public health organizations, students need to take a set of required courses in biology, chemistry, physics and mathematics and get a BS degree in Biology. Once they complete their BS degree with the highly prescribed and required courses, they would be able to apply for and get admitted into CLS or public health programs offered by various hospitals and professional institutions to obtain further clinical training and pass the examination to acquire a license to become a practicing CLS or public health professional. Because of the demand which is much like the field of nursing, hospitals offering CLS programs have been providing incentives by paying for qualified students to join their programs. The preparation for both professions at the undergraduate level is essentially the same. Most of the courses required by this emphasis are already being offered by biology, chemistry, physics and mathematics programs. The only additional required courses are BIOL 318 Medical Mycology and BIOL 426 Hematology.
2. We believe that as science majors, our students will benefit from taking MATH 230. They would learn deductive reasoning and critical thinking skills by taking this course. As a recommended course, students still have flexibility to take other courses in the A3 category.

3. BIOL 510 is a required course for the MS Biotechnology and MBA dual degree program. We believe that with the new development in stem cell technology, it is to the benefit of our students in the MS Biotechnology and Bioinformatics program to make this course available as an elective course.

4. The statement serves the same purpose of the long list of elective courses.

_________________________ 10/15/07____________________________
Ching-Hua Wang Proposer of Program Modification Date
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